

# PATENT SPECIFICATION

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## DRAWINGS ATTACHED

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## (54) IMPROVEMENTS IN OR RELATING TO ELECTROPHORETIC LACQUERING BATHS

(71) We, SIEMENS AKTIENGESELLSCHAFT, a German Company, of Berlin and Munich, Germany, do hereby declare the invention, for which we pray that a patent 5 may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to electrophoretic 10 lacquering baths.

Electrophoretic lacquering baths are nowadays constructed for intermittent or 15 continuous travel of the workpieces therethrough. In cases where a large number of articles are to be lacquered, continuous-travel installations are preferred owing to the possibility of continuous operation.

In both cases, the lacquering operation is 20 effected by precipitation of lacquering particles from an aqueous dispersion onto the article to be lacquered, which is maintained at positive unidirectional voltage. Disregarding secondary processes in the bath, a fixed 25 relationship exists between the quantity of lacquer precipitated and the quantity of current transported in this operation.

According to the present invention there 30 is provided an electrophoretic lacquering bath comprising a conductor bar on which current collectors slide for supplying current to workpieces as they travel through the bath, this bar being subdivided into individual sections along the direction of travel of the workpieces, and each current 35 bar section having a regulating unit associated therewith, these regulating units being supplied from a common voltage source and each being provided with its own current or voltage controller.

For a better understanding of the invention 40 and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawing, in which the single Figure 45 is a schematic illustration of an electro-

phoretic lacquering bath and the current supply arrangement thereof.

The electrophoretic lacquering bath 1 shown in the Figure has a conveyor (not shown) by means of which articles to be 50 lacquered, in the example shown automobile bodies 4, are passed in the direction of the arrow 10 through the bath. The solution 3 in the bath 1 consists of a dispersion of lacquer particles in salt-free 55 water. The bath wall 2 and the bodies 4 are employed as electrodes, to which a unidirectional voltage is applied. Owing to the migration of the particles which thereby occurs, the bodies 4, serving as anodes, become 60 coated with lacquer.

The supply of current to these electrodes is via the current supply arrangement which includes a distributing transformer 19, to 65 the low-voltage windings of which there are connected individual regulating units 11 to 14 independent of one another. This transformer 19, which thus serves as a common voltage source for the units 11 to 14, is supplied from a three-phase supply 70 system 24 through an isolating switch 21 and a circuit breaker 20. The regulating units 11 to 14 each consist of a semi-controlled three-phase rectifier bridge arrangement comprising thyristors 22 and rectifiers 75 23. Each of these regulating units feeds, by means of its positive voltage pole and through a direct-current contactor 15, an associated section 9 of a sectioned conductor bar extending along the bath. 80

The negative-voltage outputs of the regulating units are all at the same potential and are connected to a continuous rail 8 and to the bath wall 2. The bodies 4 are conveyed such that, except when the bodies 85 are passing between the sections 9, there is always in the region of each bar section 9 a body 4 to which positive potential is applied through a current collector 6 sliding along the bar section 9. Auxiliary elec- 90

trodes 5 situated in the interiors of the bodies 4 are supplied with negative potential through current collectors 7 sliding on the rail 8. For the sake of clarity, the current collectors 6 and 7 associated with each body 4 have been shown separated. In practice they are combined to form one unit.

Provided in association with each of the individual regulating units 11 to 14 is a 10 separate current controller 16 (in the case of each of the units 12 and 13) or (in the case of each of the units 11 and 14) a voltage controller 16', each controller 16 or 16' having an adjustable voltage source 15 18 (for example a potentiometer). In addition, there is provided at each controller 16 or 16' a pulse blocking member 17 by which the associated regulating unit can be rendered inoperative, when the current collectors 6 pass the gaps between the individual bar sections 9, so that adjacent regulating units are rendered inoperative during passage of a workpiece from the conductor bar section associated with one 20 of these units to the conductor bar section associated with the other of these units. Otherwise, transient current would be set up when two adjacent bar sections were at different voltages.

25 The current collectors 6 sliding along the sectioned conductor bar, and hence the bodies 4 suspended from the conveyor, are situated at a distance apart equal to the distance between the gaps between the individual bar sections 9.

30 The regulating units 12 and 13 are so controlled by their current controllers 16 that a constant current continuously flows to each of the bodies 4 connected with the 35 bar sections 9 associated with these units 12, 13. On the other hand, the regulating units 11 and 14 at the input and output of the bath respectively are maintained at constant voltage by their voltage controllers 40 16' in order to prevent excessively high current densities on immersion of the bodies 4 into and withdrawal from the bath.

45 For the sake of simplicity, only two bar sections 9 and regulating units 12, 13 with 50 constant current regulation have been shown. In practice, a multiplicity of individually fed bar sections 9 and associated components are situated between the endmost bar sections 9 at the input and the 55 output of the bath.

60 The described current supply arrangement has the advantage that, save for the endmost bodies 4 in the bath, there may be applied to each workpiece in the bath, independently of the others, the exact potential which produces an optimum application of lacquer. If a constant voltage is present at the electrophoretic lacquering bath, the current freely adjusts itself in 65 accordance with the constant resistance of

the lacquering bath and with the resistance of the coating of lacquer, which rises as the thickness of the latter increases, the current generally decreasing substantially in accordance with an e-function in time. The lacquering time necessary for a particular coating thickness is proportional to the current-time integral.

65 In the particular form described, thyristors are employed as regulating units. Of course, variable-gain transformers or magnetic amplifiers having sequentially connected rectifiers may also be employed. However, control by means of thyristors 80 has the advantage that the cost of the apparatus is reduced, since the thyristors may be simultaneously employed as regulating units and as rectifier elements. Moreover, the thyristors afford the possibility of regulation without time lag and rapid elimination of short-circuits in the bath.

70 In our Patent Application No. 51048/67 (Serial No. 1 203 788) there is described and claimed an electrophoretic lacquering bath comprising a conductor bar on which current collectors slide for supplying current to workpieces as they travel through the bath, this bar being subdivided into individual sections along the direction of travel of the workpieces, and each current bar section 90 having a regulating unit associated therewith, these regulating units being supplied from a common voltage source and each being provided with its own current or voltage controller, the regulating units 95 associated with each pair of adjacent conductor bar sections being arranged to receive such control orders during passage of any one of the current conductors from one bar section of the pair to the other 105 bar section of the pair that equal electrical potentials in the range of voltages necessary for electrophoresis are set up at each of these sections during this passage.

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#### WHAT WE CLAIM IS:—

1. An electrophoretic lacquering bath comprising a conductor bar on which current collectors slide for supplying current to workpieces as they travel through the bath, this bar being subdivided into individual sections along the direction of travel of the workpieces, and each current bar section having a regulating unit associated therewith, these regulating units being supplied from a common voltage source and each being provided with its own current or voltage controller.

115 2. An electrophoretic lacquering bath as claimed in claim 1, wherein the controllers of the regulating units intermediate the endmost units are current controllers.

3. An electrophoretic lacquering bath as 125 claimed in claim 1 or 2, wherein the controller of the regulating unit associated with

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the current bar section situated at the beginning of the bath is a voltage controller.

4. An electrophoretic lacquering bath as 5 claimed in claim 1, 2 or 3, wherein the controller of the regulating unit associated with the current bar section situated at the end of the bath is a voltage controller.

5. An electrophoretic lacquering bath as 10 claimed in any one of claims 1 to 4, and comprising pulse blocking means arranged to render inoperative adjacent regulating units during passage of a workpiece from the conductor bar section associated with 15 one of these units to the conductor bar section associated with the other of these units.

6. An electrophoretic lacquering bath as claimed in any one of claims 1 to 5, wherein thyristor arrangements are provided as 20 regulating units.

7. An electrophoretic lacquering bath substantially as hereinbefore described with reference to the accompanying drawing.

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